

**Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554**

In the Matter of)	
)	
Service Rules for Advanced Wireless)	WT Docket No. 07-195
Services in the 2155-2175 MHz Band)	

To the Commission

REPLY COMMENTS OF M2Z NETWORKS, INC.

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EXECUTIVE SUMMARY

In its initial comments in this proceeding, M2Z outlined proposed rules for the 2155-2175 MHz band which were intended to promote two core objectives that the Commission has espoused in countless proceedings. First, M2Z proposed that the Commission adopt technical rules that are flexible and technologically neutral, and that will permit a wide range of uses of the band. Second, M2Z proposed a series of licensee obligations and other service rules that will advance the public interest and promote the highest and best use of the 2155-2175 MHz band. There is substantial support in the record for the adoption of M2Z's proposed rules.

Despite the practical, competitive, and policy-related benefits of service rules that are technologically neutral, a few parties suggest that the Commission ignore the long-held policy and principle of technological neutrality and instead meander down the long-rejected path of prescribing the technologies and operations that are allowed in the band. The arguments for such a major departure from Commission precedent and policy are unpersuasive. Commenters proposing that the Commission establish a "downlink-only" regime fail to justify the need for these proposals and would have the Commission rely on unrealistic and inflated interference scenarios to justify the limitation. Even if their interference scenarios and predictions were accurate, which they are not, these parties still fail to demonstrate that their proposed regulatory fiat would be preferable to neutral technical parameters.

M2Z believes that it is paramount that the Commission achieve the goals of new entry and interference protection. As a practical matter, we take those two goals as a given in light of the fact that both new entry and interference protection are statutory imperatives. M2Z's careful

review of the technical analyses and engineering claims made by the downlink-only advocates and other parties favoring similar restrictions indicates that these parties:

- apply standards for “harmful interference” that are outside the mainstream of standard compatibility analysis;
- assume the use by adjacent band licensees of filters that are either too old or ineffective, or that overlap with the AWS-3 band;
- apply working thresholds for harmful interference so unreasonable that they indicate that the AWS-1 E Block licensee would interfere with the AWS-1 F Block licensee; and
- use in their analyses distance metrics that the Commission has previously discarded as inappropriately narrow for this type of analysis.

In these Reply Comments, M2Z demonstrates that:

- assuming no interference mitigation, the worst case potential for harmful interference to an AWS-1 user is a possible occurrence less than once every few months;
- the use of mitigation measures will further reduce this miniscule worst case harmful interference probability;
- the rules proposed by M2Z are consistent with the technical flexibility afforded in an analogous RF environment in the 700 MHz service rules proceeding; and
- coordination and cooperation among licensees will further protect the neighboring licensees and the AWS-3 licensee alike.

Thus, the Commission should continue to take a more sophisticated and modern view of the various mechanisms with which licensees may mitigate the potential for harmful interference.

Several parties encouraged the Commission to establish public interest obligations for the 2155-2175 MHz licensee, but others continue to believe that writing a check at auction preempts the Commission’s statutory duty to take appropriate actions that would promote the public interest. The Commission should not follow these commenters’ implicit suggestion to ignore the voice of consumers, who have vocally and consistently sought certain public interest obligations from the prospective licensee in this band and from other carriers – especially when these consumer demands have gone unmet in the marketplace. Spectrum is a valuable national asset owned by the American people. As the steward of this asset, the Commission should avoid delegating public interest determinations to the wireless industry. When adopting new rules

regarding CPNI, wireless local number portability, early termination fees, or open access commitments, the Commission has demonstrated leadership and the industry has followed.

Finally, there is near-unanimous agreement among the commenters in this proceeding that the 2155-2175 MHz band should be licensed for exclusive use within geographic service areas, rather than made available under any unlicensed or coordinated-use scheme. Exclusive licensing will help ensure the delivery of ubiquitous broadband services in the 2155-2175 MHz band, something that would not be achieved otherwise. As explained below, such licensing should take place on a nationwide basis utilizing a single 20 MHz block of spectrum in order to promote effective and intensive use of the spectrum, simplified deployment and interference mitigation, and economies of scale that will stimulate investment in new technologies and services.

M2Z thus urges the Commission to adopt M2Z's proposed service rules for the 2155-2175 MHz band, and respectfully requests that the Commission commence licensing this spectrum band as soon as possible.

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REPLY COMMENTS OF M2Z NETWORKS, INC.

M2Z Networks, Inc. (“M2Z”) hereby respectfully submits these Reply Comments in the above-captioned docket. In its initial comments¹ in this proceeding, M2Z recommended that the Commission (i) establish technologically neutral and flexible rules for AWS-3 service in the 2155-2175 MHz band and (ii) impose meaningful public interest obligations on the eventual licensee. M2Z’s proposed rules are fair to *all potential licensees* and to consumers.

Furthermore, the service rules that M2Z outlined in its initial comments would serve the public interest. A significant plurality of parties that participated in the initial round of comments supported both components of M2Z’s proposed approach. Some parties, however, saw things differently and urged the Commission to dictate the operations, uses, and choice of technology in the band. Other comments argued that the Commission should ignore the opportunity to establish licensee obligations that will, among other things, protect children, ensure rapid buildout along with timely delivery of services, and boost U.S. broadband adoption. Both the imposition of overly restrictive “command and control” technical rules and the failure to place

¹ See Comments of M2Z Networks, Inc., WT Docket No. 07-195, at 9-15 and App. A (filed Dec. 14, 2007) (“M2Z Initial Comments”).

any beneficial public interest obligations on the licensee in this band would be inappropriate in this instance. As explained below, the Commission should adopt rules that afford the benefits of a balance between technological neutrality and technical flexibility, on the one hand, and carrier responsibility on the other.

I. COMMAND AND CONTROL REGULATION IS NOT NECESSARY TO ENSURE THAT THE AWS-3 LICENSEE AVOIDS HARMFUL INTERFERENCE TO OTHER LICENSEES

The Commission has long favored flexible rules and market-based mechanisms to address interference concerns, as demonstrated most recently in the service rules the Commission adopted for the 2500-2690 MHz² and 700 MHz bands.³ As those two proceedings illustrated, the Commission often crafts service rules that are not overly restrictive from a technical and operational perspective and that incentivize neighboring licensees to seek mutually beneficial deployments.⁴ Technologically neutral and flexible service rules that accommodate both existing and future technologies, but that also facilitate the use of dynamic protection measures to limit the likelihood of harmful interference, also should be the goal for AWS-3.⁵

² See *Amendment of Parts 1, 21, 73, 74 and 101 of the Commission's Rules to Facilitate the Provision of Fixed and Mobile Broadband Access, Educational and Other Advanced Services in the 2150-2162 and 2500-2690 MHz Bands*, Report and Order and Further Notice Of Proposed Rulemaking, 19 FCC Rcd 14165, ¶¶ 132-134 (2004) (“2004 BRS/EBS Report and Order”).

³ See, e.g., *Service Rules for the 698-746, 747-762 and 777-792 MHz Bands*, Second Report and Order, 22 FCC Rcd 15289, ¶ 95 & n.215 (2007) (“700 MHz August 2007 Second Report and Order”).

⁴ See 47 CFR § 22.359(c) (“Licensees in the Public Mobile Services may establish an alternative out of band emission limit to be used at specified frequencies (band edges) in specified geographical areas, in lieu of that set forth in this section, pursuant to a private contractual arrangement of all affected licensees and applicants.”); *id.* § 22.861(c) (granting the same flexibility to negotiate to commercial aviation air-ground systems and affected licensees of Cellular Radiotelephone Service systems operating in the spectrum immediately below and adjacent to the commercial aviation air-ground bands); see also *id.* § 22.917(c) (granting similar flexibility for Cellular Radiotelephone Service); *id.* § 24.237(a) (requiring to broadband PCS licensees to “coordinate their frequency usage with co-channel or adjacent channel incumbent fixed microwave licensees”); *id.* § 27.53(a)(10) (“The out-of-band emissions limits in paragraphs (a)(1) through (a)(9) of this section may be modified by the private contractual agreement of all affected licensees.”).

⁵ As discussed in greater detail below, M2Z proposes flexible service rules that would closely follow the current 700 MHz service rules in this regard.

The majority of parties commenting on various technical aspects of the NPRM in this proceeding joined M2Z in advocating a flexible approach, consistent with existing Commission policy.⁶ For example, Sprint Nextel explained that “[f]ully flexible, technology-neutral rules offer all potential AWS-3 bidders the opportunity to respond to enormous public demand for new, innovative, and affordable mobile broadband applications in the United States.”⁷ Similarly, CTIA asserted that “the Commission should provide licensees with the freedom to innovate through flexible service rules while ensuring that both new and incumbent licensees are protected from harmful interference.”⁸ ArrayComm explained the practical benefit of establishing rules that are technically neutral, indicating that “the uplink/downlink use approach would allow for the most spectrally efficient use of the AWS-3 band.”⁹ ArrayComm also noted that “technical solutions exist that will allow both uplink and downlink transmissions to occur in the AWS-3 band that do not cause interference to adjacent spectrum holders.”¹⁰

The comments filed in this proceeding demonstrate conclusively that there is no need for the Commission to deviate from its clear policies in favor of technological neutrality and flexibility. Nevertheless, a few parties have advocated the introduction of unreasonably

⁶ See Comments of ArrayComm LLC, WT Docket No. 07-195, at 4-7 (filed Dec. 14, 2007) (“ArrayComm Comments”); Comments of CTIA – the Wireless Association, WT Docket No., 07-195, at 5 (filed Dec. 14, 2007) (“CTIA Comments”); Comments of Sprint Nextel Corporation, WT Docket No. 07-195, at 2-4 (filed Dec. 14, 2007) (“Sprint Nextel Comments”); Comments of Free Press, Media Access Project, New America Foundation, and Public Knowledge, WT Docket No. 07-195, at 13 (filed Dec. 14, 2007) (“Free Press *et al.* Comments”); Comments of the Minority Media and Telecommunications Council and the Rainbow/PUSH Coalition, WT Docket No. 07-195, at 7 (filed Dec. 14, 2007) (“MMTC and Rainbow/PUSH Comments”); Comments of QUALCOMM Incorporated, WT Docket No. 07-195, at 3-4 (filed Dec. 14, 2007); Comments of the Wireless Communications Association International, Inc., WT Docket No. 07-195, at 6-9 (filed Dec. 14, 2007) (“WCA Comments”); Comments of New ICO Satellite Services G.P., WT Docket No. 07-195, at 2 (filed Dec. 14, 2007).

⁷ Sprint Nextel Comments at ii.

⁸ CTIA Comments at 2.

⁹ ArrayComm Comments at 4.

¹⁰ *Id.* at 9.

restrictive technical rules, namely, the restriction of the band to downlink-only operations.¹¹ In many cases, these proposals are inconsistent with the prior advocacy of these parties in other proceedings.¹² Adoption by the Commission of these overly restrictive proposals would violate a core Commission tenet of technological neutrality while also unfairly favoring incumbent carriers and existing spectrum holders and prohibiting deployment of the very services that consumers already have sought in the band. The Commission should reject these calls for the return of command and control technical rules.

Notably, some commenters supporting the downlink-only proposal set forth in the NPRM issued in this proceeding¹³ vastly overstate the threat of harmful interference posed by rules that would allow both downlink and uplink operations. These commenters resort to rationales that ignore Commission precedent as well as modern engineering analysis methods that more accurately assess the risk of harmful interference. Terrestar and T-Mobile's analyses are particularly guilty of this offense.¹⁴ Parties that attempt to provide a greater amount of additional analysis, such as Verizon Wireless and Motorola, also ignore Commission precedent and modern engineering analysis methods, and they compound these errors by making significant mistakes in their methodology and substantive findings.¹⁵

¹¹ See Comments of Verizon Wireless, WT Docket No. 07-195, at 13-15 (filed Dec. 14, 2007) ("Verizon Wireless Comments"); Comments of T-Mobile USA, Inc., WT Docket No. 07-195, at 2-7 (filed Dec. 14, 2007) ("T-Mobile Comments"); Comments of Motorola, Inc., WT Docket No. 07-195, at 5-9 (filed Dec. 14, 2007) ("Motorola Comments"); Comments of TerreStar Networks Inc., WT Docket No. 07-195, at 2-4 (filed Dec. 14, 2007) ("TerreStar Comments").

¹² See *infra* note 24 and accompanying text; *infra* notes 38-39 and accompanying text; *infra* notes 43-44 and accompanying text.

¹³ See *Service Rules for Advanced Wireless Services in the 2155-2175 MHz Band*, Notice of Proposed Rulemaking, 22 FCC Rcd 17035, ¶ 21 (2007) ("NPRM").

¹⁴ See T-Mobile Comments at 8-9; TerreStar Comments at 2-4. TerreStar provides no specific technical analysis when it "urges the Commission not to permit TDD/HFDD mobile transmissions in the AWS-3 band." *Id.* at 4.

¹⁵ See, e.g., Verizon Wireless Comments at 13-15; Motorola Comments at 3-9. The substantive flaws in these various engineering analyses are discussed more fully in Part II below.

Several commenters also espouse positions that are inconsistent and at odds with those they advanced in a recent proceeding. In the Upper 700 MHz band, the Commission addressed many of the same issues present in this proceeding yet adopted flexible technical and service rules that allowed a host of operations.¹⁶ In the end, the Commission found that a “flexible, market-based approach is the most appropriate method for determining service rules in [the 700 MHz] band.”¹⁷ The AWS-3 and AWS-1 band plans are similar, in many respects, to the 700 MHz band, and the rules presently under consideration should follow the same approach, which permits both paired (*i.e.*, FDD) and unpaired (*i.e.*, TDD) operations¹⁸ throughout the commercial blocks.¹⁹ The Commission recently both affirmed and refined its decision in favor of flexibility by revising the power limits to “better enable Time Division Duplex (TDD) technologies to operate on these bands.”²⁰ In 2007, the Commission retained this approach in its final band plan and service rules in order to permit “provision of the full range of FDD- and TDD-based wireless

¹⁶ See *Service Rules for the 746-764 and 776-794 MHz Bands, and Revisions to Part 27 of the Commission’s Rules*, First Report and Order, 15 FCC Rcd 476 (2000) (“700 MHz First Report and Order”); see also *Service Rules for the 746-764 and 776-794 MHz Bands, and Revisions to Part 27 of the Commission’s Rules*, Second Report and Order, 15 FCC Rcd 5299 (2000); *Service Rules for the 746-764 and 776-794 MHz Bands, and Revisions to Part 27 of the Commission’s Rules*, Memorandum Opinion and Order and Further Notice of Proposed Rulemaking, 15 FCC Rcd 20845 (2000) (“700 MHz Memorandum Opinion and Order”).

¹⁷ See *700 MHz First Report and Order* ¶ 2.

¹⁸ See 47 C.F.R. § 27.50. Although the Lower 700 MHz band (698-746 MHz) contains three paired blocks, the service rules allow fixed, mobile, and portable services, which would allow for TDD operations. This is also true of the four paired blocks in the Upper 700 MHz band (746-764 MHz and 776-794 MHz), where the two larger blocks (namely, the C Block and the D Block) may be used to provide fixed, mobile, and portable services.

¹⁹ See *700 MHz First Report and Order* ¶ 42 (explaining that “[t]he majority of commenters note . . . that Frequency Division Duplex (FDD), which is the most commonly-used transmission procedure for PCS, cellular, and other mobile telephony applications, requires paired spectrum” and that “[p]airing of these bands under these circumstances will facilitate the auction procedure, by not requiring bidders seeking paired bands to prepare multiple bids. . . . because paired bands are essential to these technologies”). Yet, the Commission noted in the same Report and Order that “technologies using unpaired spectrum can operate on paired segments” and allowed for the “post-auction unpairing of this spectrum.” *Id.*

²⁰ See *700 MHz Memorandum Opinion and Order* ¶ 2 (further indicating that the Commission had decided to retain a paired spectrum band plan but “revise certain [] technical rules to help establish a neutral regulatory scheme in which competing wireless technologies may contend”).

services.”²¹ Notably, of the parties that opposed flexible rules and the uplink/downlink approach proposed in the instant NPRM,²² to M2Z’s knowledge only Motorola filed in opposition to the 700 MHz rules (and it did so only to advocate protection for operations within the Public Safety blocks, not the commercial blocks).²³ Conversely, Verizon Wireless opposed technical flexibility in its initial comments in this 2155-2175 MHz proceeding, but Verizon Wireless and its predecessor entity Bell Atlantic were longtime proponents of technical flexibility in the 700 MHz proceeding.²⁴

A. Harmful Interference between AWS-3 and Future Operations in Other Bands is Unlikely and Best Managed Through Technologically Neutral Means

The Commission has more recently employed probabilistic methods to analyze the potential for harmful interference in scenarios involving mobile device users that occasionally come within close proximity of each other. For example, Commission decisions addressing ultra-wideband (“UWB”) emissions,²⁵ the Wireless Communications Service (“WCS”),²⁶ and the

²¹ See *700 MHz August 2007 Second Report and Order* ¶ 94 (“[T]he Commission provided for a flexible use approach with respect to the services and technologies, including provision of the full range of FDD- and TDD-based wireless services.”) (internal quotation marks omitted).

²² See NPRM ¶¶ 11, 13-18.

²³ See Reply Comments of Motorola Inc., WT Docket No. 06-150, at 11-12 (filed June 4, 2007).

²⁴ See, e.g., Letter of Donald C. Brittingham, Bell Atlantic, to Ms. Magalie Roman Salas, Secretary, Federal Communications Commission, WT Docket No. 99-168, at 3 (filed Nov. 17, 1999) (“The Commission should adopt flexible technical rules comparable to those used for PCS with field strength limits to minimize interference at the market borders and out-of band emission limits to protect operators in adjacent channels, e.g. Public Safety.”); see also Opposition of Bell Atlantic Mobile, Inc. to Petition for Reconsideration of APCO, WT Docket No. 99-168, at 1-2 (filed March 10, 2000). Even with sensitive public safety operations at issue, Bell Atlantic Mobile argued in this opposition that “overly restrictive out-of-band emissions limits” would “place an unwarranted burden on commercial operators, significantly reduce the amount of useable commercial spectrum, and reduce the value of the spectrum to potential bidders.” *Id.* Even after years of contemplating the rules, with ample opportunity to consider whether they should be less flexible, the company stated “Verizon Wireless hereby responds to the Commission’s request for comments on the appropriate service rules for the 698-746, 747-762 and 777-792 MHz bands. Verizon Wireless does not believe that substantial changes to these rules are necessary.” See Comments of Verizon Wireless, WT Docket No. 06-150, at 1 (filed Sept. 29, 2006).

²⁵ See, e.g., *Revision of Part 15 of the Commission’s Rules Regarding Ultra-Wideband Transmission Systems*, 17 FCC Rcd 7435 (2002) (“UWB Order”).

PCS H Block²⁷ all utilized such methods. Nevertheless, despite the reality that harmful interference from an AWS-3 licensee to other licensees is extremely unlikely, as explained *infra*, a handful of parties argue that interference protection for licensees in the adjacent bands should be absolute and should be based on static, worst-case scenarios, using a separation distance of no more than one-meter between the AWS-3 mobile device and the neighboring band mobile device.²⁸ These parties' comments dramatically overstate the relevant interference concerns because they ignore Commission precedent that requires analysis of both the impact of proximity and the probability that a harmful interference condition will exist.

The interference issues raised in this proceeding relate to hypothetical harmful interference from a new AWS-3 licensee to a licensee for a yet-to-be-deployed system in the lower adjacent band (the AWS-1 F Block) or a potential upper adjacent band licensee in a band of spectrum that has neither service rules nor any current license assignments (the AWS-2 J Block). Establishing new service rules that will enable adjacent band operations is hardly new ground for the Commission, and M2Z believes the Commission should again rely on its long-standing precedent to establish neutral and flexible technical rules rather than the overly restrictive rules suggested by some parties.

In the recent MVDDS,²⁹ UWB, and WCS rulemakings, the Commission determined in each proceeding the amount of harmful interference protection to which incumbents were

²⁶ *Amendment of the Commission's Rules to Establish Part 27, the Wireless Communications Service ("WCS")*, Memorandum Opinion and Order, 12 FCC Rcd 3977 (1997) ("*WCS MO&O*").

²⁷ *Amendment of Part 2 of the Commission's Rules to Allocate Spectrum Below 3 GHz for Mobile and Fixed Services to Support the Introduction of New Advanced Wireless Services, including Third Generation Wireless Systems*, Sixth Report and Order, Third Memorandum Opinion and Order, and Fifth Memorandum Opinion and Order, 19 FCC Rcd 20720 (2004) ("*PCS H Block Order*").

²⁸ *See, e.g.*, CTIA Comments at 5-6; Motorola Comments at 6-7; T-Mobile Comments at 8-9; Verizon Wireless Comments at 6, 11, 13.

²⁹ *See, e.g., Amendment of Parts 2 and 25 of the Commission's Rules to Permit Operation of NGSO FSS Systems Co-Frequency with GSO and Terrestrial Systems in the Ku-Band Frequency Range*, Memorandum Opinion and Order and Second Report and Order, 17 FCC Rcd 9614 (2002) ("*MVDDS MO&O*").

entitled. The MVDDS rulemaking considered the rights of DBS incumbents and whether they would be required to share their band involuntarily with a new entrant offering a fixed service (“FS”).³⁰ In addition, the UWB proceeding and the rules adopted therein considered the rights of existing operators in – not just next to – the bands sought by UWB advocates. The incumbent licensees’ uses were unambiguously primary with respect to the unlicensed technology under consideration for the UWB band.³¹ In both cases, the Commission’s decisions respected the rights of incumbents, but did not give incumbents the overly broad protections that they had requested.³² The Commission thus balanced the benefits of promoting the introduction of new services – even unlicensed services, in the case of UWB – against the minimal risk of harmful interference, and found that incumbents could be sufficiently protected through the use of neutral rules regarding transmit power. M2Z respectfully submits that if even unlicensed operators in a new service deserve some consideration and the benefit of neutral technical rules, the eventual AWS-3 licensee deserves at least as much consideration. Following such precedent, the Commission should establish neutral technical rules that permit new services, including potential two-way services, in the 2155-2175 MHz band.

The Commission’s decision in its UWB rulemaking demonstrates the inadequacies of the analysis submitted by parties in this proceeding that seek to prohibit two-way transmissions in the 2155-2175 MHz band. As the Commission explained in response to proposals to restrict UWB communications device operations in order to protect PCS operations in the UWB proceeding, “we do not believe it is appropriate to use such a close [one-meter] separation distance as the basis for controlling harmful interference. Any interference at close distances can

³⁰ See, e.g., *id.* ¶ 25.

³¹ See 47 CFR § 15.5.

³² See, e.g., *MVDDS MO&O* ¶¶ 86-94.

be easily remedied by moving the devices a short distance apart.”³³ The Commission explained further that these separation distances were based on “worst case conditions as they do not assume that there is additional attenuation of the UWB emissions due to intervening objects, mismatched antenna polarizations, head loss, or other effects” and that they “also assume that the UWB transmitter is operating at its maximum emission limit with the emission directed at the PCS receiver.”³⁴ Thus, if a one-meter separation is an inappropriately close distance assumption for the interaction of handheld PCS and unlicensed UWB devices operating in the same band, then it is an inappropriate separation distance to use in this proceeding as well.

The UWB proceeding clearly demonstrated the Commission’s distaste for imposing unnecessarily restrictive technical limits. The Commission adopted a technically flexible approach in that proceeding, even though it was balancing the needs of incumbent PCS licensees against potential harmful interference from unlicensed UWB communications devices operating on a non-harmful interference basis. In addition to rejecting interference analyses based on the assumption of transmissions in very close proximity, the UWB decision also found that static, worst-case assumptions regarding harmful interference potentials should not dictate the content of its technical rules.³⁵

In its deliberations on WCS, the Commission refused to provide licensees in the adjacent Satellite Digital Audio Radio System (“SDARS”) service absolute protection against potential harmful interference from the new WCS service, recognizing the need to balance the interests and needs of the adjacent services and to “limit the potential for interference to a reasonable level

³³ *UWB Order* ¶ 159.

³⁴ *Id.* ¶ 162.

³⁵ *See id.*

– not to provide a pure, interference-free environment.”³⁶ Again, the Commission refused to rely on worst-case harmful interference assumptions, and refused to let such improper assumptions dictate the eventual service rules for the WCS band. The Commission also resisted similar “sky-is-falling” scenarios in its MVDDS decision³⁷

B. The Commission Should Analyze the Potential for Harmful Interference Using Probabilistic Analysis

In the instant proceeding, T-Mobile argues against the operation of uplinks in the AWS-3 band based on worst-case, static scenarios.³⁸ Yet, as recently as two years ago in the PCS H Block proceeding, T-Mobile maintained that the probabilistic approach was valid in evaluating PCS H Block interference to GSM handsets. At that time, T-Mobile told the Commission: “Industry tests suggest that H Block handsets may interfere with GSM handsets when several conditions exist. T-Mobile believes that the likelihood of [such] conditions existing is relatively low.”³⁹ Sprint Nextel also supported a probabilistic view of interference in the H Block proceeding, but, unlike T-Mobile, Sprint Nextel maintains consistency and supports technological neutrality and flexibility in this proceeding as well. In the H Block proceeding, Sprint Nextel enumerated the set of conditions, all of which must occur simultaneously for there to be any potential for harmful interference, explaining that “[t]here are four major factors to

³⁶ *WCS MO&O* ¶ 25.

³⁷ See, e.g., *Amendment of Parts 2 and 25 of the Commission’s Rules to Permit Operation of NGSO FSS Systems Co-Frequency with GSO and Terrestrial Systems in the Ku-Band Frequency Range*, First Report and Order and Further Notice of Proposed Rulemaking, 16 FCC Rcd 4096, ¶ 213 (2000) (“We conclude that MVDDS can operate in the 12.2-12.7 GHz band under the existing primary allocation, which requires that a Fixed Service not cause harmful interference to the co-primary BSS.”) The Commission noted that “Section 2.1 of our rules defines ‘harmful interference’ as ‘interference which endangers the functioning of a radionavigation service or of other safety services or *seriously degrades, obstructs, or repeatedly interrupts a radiocommunication service.*” *Id.* (emphasis in original). The Commission found that it could “develop operating requirements for MVDDS that will ensure that DBS operations are not seriously degraded or subject to repeated interruptions due to MVDDS operations, thus avoiding any harmful interference to DBS.” *Id.*

³⁸ See T-Mobile Comments at 5-6, 8-9.

³⁹ T-Mobile USA, Inc. *Ex Parte* Presentation, WT Docket Nos. 02-353 and 04-356, at 4 (filed Sept. 15, 2005).

consider in the probability analysis” – power, sensitivity, and proximity of the devices, as well as simultaneity of all three of these conditions.⁴⁰ The probabilistic analysis previously advocated by T-Mobile and consistently advanced by Sprint Nextel is the appropriate method for analyzing the probability of harmful interference from the eventual AWS-3 licensee to the adjacent bands – even for potential harmful interference from a licensee using TDD technology in the 2155-2175 MHz band to an adjacent band licensee using FDD technology.⁴¹

Ultimately, the Commission’s decision in the H Block proceeding recognized the need to consider probability in determining the risk of potential harmful interference. In that decision, the Commission concluded that predictions that depended on a “short distance[,] coupled with the low probability of occurrence of the worst-case scenario (both mobiles at the edge of coverage, both operating at the edge of the band, both simultaneously active, and both in close proximity to each other) make interference of this nature highly unlikely.”⁴²

T-Mobile is not the only party in this proceeding to take an approach directly contrary to its advocacy for probabilistic methodologies in other Commission proceedings. TerreStar proposed in its comments in response to the 2155-2175 MHz MPRM a command and control approach to mitigating potential harmful interference in the 2155-2175 MHz band.⁴³ Just four days after filing those comments, however, TerreStar reversed course and emphasized to the Commission the importance of utilizing a probabilistic analysis concerning its own operations,

⁴⁰ Sprint Nextel Corporation *Ex parte* Presentation, WT Docket No. 04-356, at 16 (filed Sept. 14, 2005).

⁴¹ This is true even though the technical nature of the potential interference in the two cases differs. In the H block case, the main concern was receiver-generated intermodulation interference – the same technical problem present in the Nextel/public safety 800 MHz proceeding and at the base of the FAA’s concerns about interference to Instrument Landing System avionics from FM near 108 MHz. In the H Block case there was also some concern over adjacent channel interference. *See, e.g., PCS H Block Order* ¶ 8.

⁴² *PCS H Block Order* ¶ 25.

⁴³ *See* TerreStar Comments at 4 (suggesting that interference concerns be resolved by prohibiting certain technologies).

arguing that “an extremely unlikely confluence of factors is required for there even to be a potential interference event.”⁴⁴

There is ample precedent and support for evaluating the risk of harmful interference in terms of realistic probabilities, not worst-case static situations. While there will always be a remote chance that an unwelcome event could occur, the Commission should not establish service rules designed to account for the most unlikely events. This is particularly true when the infinitesimal chance of harmful interference is combined with the reality that, as the Commission has recognized in other contexts, “[a]ny interference at close distances can be easily remedied by moving the devices a short distance apart.”⁴⁵ M2Z urges the Commission to evaluate the risk of harmful interference in terms of realistic probabilities, not worst-case static situations.

As T-Mobile and Sprint Nextel explained in the context of the H Block proceeding, several conditions must occur simultaneously in order for an AWS-3 mobile uplink transmission to interfere with an adjacent band mobile downlink reception. Such interference concerns would be potentially most severe when a mobile device operating in AWS-3 is in close spatial proximity to a mobile device operating in an adjacent band. For harmful interference to occur in such a scenario, there would need to be a nearly simultaneous occurrence of three different conditions, with the mobile devices (1) operating close in space; (2) operating close in frequency;⁴⁶ and (3) overlapping in time. Furthermore, the simultaneous occurrence of these three events still would be insufficient to result in harmful interference, as there must be a fourth

⁴⁴ See Comments of TerreStar Networks, Inc., WT Docket No. 02-55, at 8 n.14 (filed Dec. 18, 2007). After listing each of these events, the company claimed “that in the 100 largest markets there would at most be a single interference event every 2.2 years.” *Id.*

⁴⁵ *UWB Order* ¶ 159.

⁴⁶ Respective devices’ transmitting and receiving frequencies must be spectrally close. This would mean that: (1) both mobiles are CMRS subscribers; (2) both subscribers have devices in the on position; (3) one user is assigned a channel in the AWS-3 band; and (4) the channel one user is assigned in the AWS-3 band is directly adjacent to the channel on which the other subscriber is operating.

condition present: a “near/far” power situation (in which the adjacent band handset is receiving weak signals from a distant base station) must exist as well.⁴⁷

Ofcom examined this issue in detail to assess interference concerns similar to those posed regarding the uplink/downlink approach sought in the 2155-2175 MHz band.⁴⁸ The study prepared for Ofcom notes that there are multiple factors that affect the probability of interference, including the position of the handset within the cell and the load on the system.⁴⁹ Importantly, this study found that 1.9% of mobile devices operating in areas with high user-density might suffer the effects of mobile-to-mobile interference 1.4% of the time, under the worst-case assumption that the physically nearby users were also using adjacent channels.⁵⁰ Given the specific characteristics of AWS-3, analysis by M2Z determined that the worst case potential for harmful interference to an AWS-1 user would predict a potential occurrence less than once every few months.⁵¹ These low probability figures merely provide a baseline for the likelihood of harmful interference. The use of more advanced filter technology and mitigation techniques (as discussed in Appendix A to these Reply Comments), such as adaptive antennas, cognitive radio, and mobile handover, can further reduce incidents of harmful interference. The study prepared for Ofcom explicitly recognized this fact, acknowledging that adaptive antenna

⁴⁷ Radio receivers are susceptible to “near/far” problems – that is they have a limited capability of receiving and detecting a weaker signal in the presence of a stronger signals.

⁴⁸ Mason Communications, Ltd., “2500-2690MHz, 2010-2025MHz and 2290-2302MHz Spectrum Awards – Engineering Study (Phase 2)” (Nov. 2006), available at <http://www.ofcom.org.uk/consult/condocs/2ghzawards/masonresearch.pdf>.

⁴⁹ *Id.* at 7. Mason concludes that, based on the specific details of the band and the technology available at the time of the study, either a guard band or additional mitigation techniques were needed to control interference. However, this specific conclusion depends on details that do not necessarily apply for the U.S. band plan and in light of currently available filter and mitigation technologies (*e.g.* smart antennas and cognitive radio).

⁵⁰ *Id.* at 37 and App. A.

⁵¹ M2Z estimates that, in the worst case, 0.64% of the devices in dense user areas might suffer effects of mobile to mobile interference for 0.15% of the time in the absence of any interference mitigation techniques. This equates to a possible event once every 2.4 months.

technology would “significantly reduce the probability of interference.”⁵² In addition, the study did not address the common use of multi-band radios that can further reduce the potential for harmful interference by allowing the operator to hand over the mobile user to a completely different band (such as the 900 MHz, 1900 MHz, or 2.5 GHz bands).⁵³

Probabilistic analysis is also routinely employed by well-respected foreign regulatory authorities as a basis for their technical decisions. In 1999, the European Radiocommunications Committee (“ERC”) issued a report that examined methods for calculating the potential for interference in order to address the same technical problem raised in the AWS-3 proceeding, *i.e.*, determining whether TDD use in AWS-3 would impact FDD use in neighboring bands. The ERC found the probabilistic approach more spectrally efficient and prudent than the worst-case approach used by those opposing use of TDD technology.⁵⁴ More recently, Ofcom also used a probabilistic analysis to determine technical parameters for TDD operations.⁵⁵ From these examples, it is evident that both Commission precedent and prevailing practice in many other

⁵² *Id.*, App. A, at 10.

⁵³ Many operators have spectrum holdings in several bands and have deployed multi-band handsets. For example, Verizon Wireless CDMA handsets can tune to the 800 MHz and 1900 MHz bands. See Verizon Wireless Press Release, “Verizon Wireless and Samsung Introduce Ultimate Global Productivity Wireless Device,” (Jan. 4, 2006) (describing device that comes equipped with a quad-band frequency operation), available at <http://news.vzw.com/news/2006/01/pr2006-01-04a.html>. AT&T Wireless GSM handsets can tune to the 850 MHz and 1900 MHz bands in the U.S. and 900 MHz and 1800 MHz bands overseas. See AT&T Press Release, “AT&T, Samsung Up the Ante with the New BlackJack II Smart Device” (Oct. 23, 2007) (discussing tri-band 3G and quad-band EDGE/GPRS devices), available at <http://www.att.com/gen/press-room?pid=4800&cdvn=news&newsarticleid=24595>; see also Apple Press Release, “Apple Reinvents the Phone with iPhone” (Jan. 9, 2007) (discussing quad-band GSM phone), available at <http://www.apple.com/pr/library/2007/01/09iphone.html>. Sprint Nextel has reportedly been developing for some time a dual-band, dual-mode capability handset to use its 1900 MHz EV-DO CDMA network in conjunction with its planned 2.5 GHz WiMAX network. See, e.g., Brad Smith, “Whither Thou Goest, Will WiMAX Follow?” *Wireless Week* (Oct. 13, 2006), available at <http://www.wirelessweek.com/whither-thou-goes-will-wimax.aspx?terms>.

⁵⁴ European Radiocommunications Committee, “A Comparison of the Minimum Coupling Loss Method, Enhanced Minimum Coupling Loss Method, and the Monte-Carlo Simulation,” ERC Report 101, at 31 (May 1999), available at <http://www.erodocdb.dk/doks/filedownload.aspx?fileid=2017&fileurl=http://www.erodocdb.dk/Docs/doc98/official/pdf/REP101.PDF>.

⁵⁵ Ofcom (UK), Discussion Document “Award of available spectrum: 2500-2690MHz, 2010-2025MHz” (Aug. 1, 2007), available at <http://www.ofcom.org.uk/consult/condocs/2ghzdiscuss/main.pdf>.

countries reject the application of worst-case scenarios for determining interference protection parameters and instead justify such parameters based on probabilistic analysis.

II. THE COMMISSION SHOULD DISREGARD THE MISGUIDED INTERFERENCE ANALYSES PROVIDED BY COMMENTERS SUPPORTING THE DOWNLINK-ONLY PROPOSAL

A. The Interference Analyses Set Forth By Verizon Wireless, Motorola and T-Mobile Inappropriately Rely on Several Incorrect Assumptions and Assume the Use of Ineffective Filters

As the Commission recognizes, allowing for both mobile and base transmissions in the AWS-3 band presents certain adjacent channel and co-channel interference concerns.⁵⁶ Specifically, such use could result in harmful interference, if not addressed and mitigated as discussed below, whenever two or more mobile devices are in close physical proximity and operate in the same frequency band or in adjacent bands that are close to one another.⁵⁷ In its comments, Verizon Wireless contends that AWS-3 mobile devices would have to be limited to a very low power in order to avoid causing harmful interference to AWS-1 mobile receivers⁵⁸ and argues that the downlink-only approach is the only viable option for use of the AWS-3 band. As discussed below, these arguments are misguided.

Verizon Wireless's analysis relies on the H Block test results conducted in 2005,⁵⁹ as

⁵⁶ NPRM ¶ 11.

⁵⁷ Radio interference can occur in several ways, including: (1) receiver overload (adjacent channel interference); (2) out-of-band emissions (OOBE); and (3) intermodulation distortion (IM). Receiver overload interference occurs when an interfering signal in an adjacent band is strong enough to desensitize the mobile receiver. OOBE interference results when a carrier transmits part of its power into adjacent channels. Receiver overload and OOBE interference can be mitigated by the application of radio frequency (RF) filters at the receiver and transmitter, respectively. IM distortion, which occurs from the combination of an adjacent signal with a receiver's transmit frequency, is not an issue in the AWS-1 and AWS-3 frequencies since the IM products would be considerably out-of-band for the AWS-1 receiver.

⁵⁸ See Verizon Wireless Comments at 13.

⁵⁹ See *id.* at 6, 10-14, "Review of H-Block Test Results with PCS Handsets," V-COMM Presentation, filed with Ex Parte Letter of Donald Brittingham, Verizon Wireless, to Marlene H. Dortch, Secretary, Federal Communications Commission, WT Docket No. 04-356 (filed Sept. 21, 2005).

well as interference tests conducted by Motorola using CDMA mobile devices,⁶⁰ to determine that AWS-3 mobile devices should be limited to a maximum transmit power of 0 dBm in order to avoid interference to mobile devices operating in the AWS-1 band. Verizon Wireless's argument, however, depends upon several highly suspect assumptions:

- a one-meter separation distance;
- a significantly lower interference threshold than that used by Motorola in its tests; and
- AWS receiver filters that by design do not provide any attenuation and isolation of AWS-3 mobile transmitters.

First, as discussed above, a one-meter spatial separation for evaluating mobile-to-mobile harmful interference is misleading and has been disavowed in previous Commission proceedings.⁶¹ Mobile-to-mobile interference exists only when several interference conditions occur simultaneously. As explained above, in most situations in which AWS-3 and AWS-1 mobile devices may be in close proximity, the actual likelihood would be low for any mobile-to-mobile harmful interference occurring at all. Therefore, the use of a one-meter spatial separation metric and a non-probabilistic, cookie cutter interference analysis methodology ignores the majority of situations where mobile devices are in close proximity and harmful interference is not an issue.

Second, whereas Motorola in its recent AWS tests appropriately used dropped calls as the reference point for determining when harmful interference occurs, Verizon Wireless used an interference level that is 8 dB less than the level used by Motorola. Verizon Wireless claimed that a small increase in the frame error rate ("FER") was a more accurate determinant of harmful

⁶⁰ See Motorola Comments at 3-4.

⁶¹ See *supra* note 33.

interference to a mobile device⁶² and defined harmful interference as occurring at the level at which the FER increases by 1-2% of the baseline reference. The reference FER used by Verizon Wireless, however, exceeds by a significant margin the FER specified for current state-of-the-art mobile technology.⁶³ In addition, Verizon Wireless fails to justify the determination of this value and the practical effect, if any, that this FER would have on call performance and quality.⁶⁴

Third, Motorola's tests did not assume any attenuation or isolation of the AWS-3 transmitter due to filtering. AWS filters currently are being manufactured to cover the entire 2110-2175 MHz band,⁶⁵ and these filters will not provide any rejection and isolation of AWS-3 mobile transmitters. Motorola's results, as expected, saw inadequate rejection of the adjacent AWS-3 channel, which resulted in overload of the AWS-1 mobile receiver.⁶⁶ Verizon Wireless attempted to extrapolate the results of the H Block tests to conclude that the harmful interference

⁶² Motorola used a reference interference level of -34 dBm, which it determined would produce a dropped call. Verizon, using data from previous H Block testing of PCS handsets by Motorola and CTIA, used instead an interference level of -42 dBm. This interference level would increase the FER by 1-2% of the baseline reference.

⁶³ The 3GPP standards for the Block Error Ratio (downlink) specify a variation of $0.01 \pm 30\%$, a significantly greater margin of error than the 1-2% used in the Verizon analysis (*see* 3GPP TS 25.101 § 8.8.1.1, Table 8.30B).

⁶⁴ M2Z notes that with the receivers used and at the interference threshold derived in the Verizon Wireless and Motorola tests and analyses, receiver overload also would occur in-band from AWS-1 base station operations in adjacent blocks (*e.g.*, F Block base station transmitters that are adjacent to E Block mobile receivers). For example, repeating the Verizon analysis for base station power of 60 dBm EIRP at 2.1 GHz, the minimum mobile-to-base station separation would need to be about 1,400 meters in order to avoid an interference level at the receiver of -42 dBm. Following this analysis, similar overload problems could occur in adjacent PCS blocks. If this is indeed a problem, mobile system operators with multiple bands (*e.g.*, PCS and AWS-1) can mitigate such interference by handover of the mobile to another base station operating in another band.

⁶⁵ The filters are designed with a large range to accommodate the various AWS bands used worldwide: UMTS Band IV: 2110-2155 MHz (U.S. AWS-1 band); UMTS Band X: 2110-2170 MHz (South America); and UMTS Band I: 2110-2170 MHz (Europe and Asia).

⁶⁶ Thus, the analysis that Verizon Wireless and Motorola appear to rely upon in their comments depends on the use of commercially available filters that can not provide any isolation of the AWS-3 band. Although filters designed to provide isolation of the AWS-3 band are not available commercially, this lack of commercial availability is not due to any technological constraint. AWS-1 licensees have been on notice for years that services, including TDD services, could enter the 2155-2175 MHz band. In 2003, for example, the Commission expressly noted that this 20 megahertz spectrum block "could be used to provide an asymmetric pairing or TDD operations." *See Amendment of Part 2 of the Commission's Rules to Allocate Spectrum Below 3 GHz for Mobile and Fixed Services to Support the Introduction of New Advanced Wireless Services, Including Third Generation Wireless Systems*, Third Report and Order, Third Notice of Proposed Rulemaking, and Second Memorandum Opinion and Order, 18 FCC Rcd 2223, ¶ 69 (2003) ("AWS Third Report and Order").

potential between AWS-3 and AWS-1 is comparable to that between the H Block and nearby PCS spectrum. Using the H Block test results is disingenuous at best, however, because the tests conducted at that time involved a mix of PCS handsets, the majority of which used older filter technology that could not provide adequate rejection of H Block interference.⁶⁷ As Verizon Wireless recognizes, newer technology filters that provided additional rejection capabilities and isolation of the H Block were in use in a smaller percentage of the handsets deployed at that time.

Similarly, in its comments T-Mobile argued that if mobile transmit or uplink operations were allowed in the band, then AWS-3 mobile devices would have to be limited to a very low power level in order to protect T-Mobile's yet-to-be deployed UMTS mobile receivers in the adjacent AWS-1 spectrum block.⁶⁸ T-Mobile relied on UMTS design parameters to determine that AWS-3 mobile receivers should be limited to a maximum transmit power of 17 dBm.⁶⁹ As did Verizon Wireless and Motorola, however, T-Mobile assumed a one-meter spatial separation. As discussed above, use of a one-meter spatial separation is unwarranted and vastly overestimates the likelihood of harmful interference. Indeed, even using T-Mobile's assumptions and methodology, AWS-3 mobile devices would be permitted to operate at a distance of approximately two meters from a UMTS mobile device at reasonable and viable power levels without causing harmful interference.⁷⁰

⁶⁷ See *supra* note 57 (explaining that receiver overload and OOB harmful interference can be mitigated by using RF filters at the receiver and transmitter, respectively).

⁶⁸ See T-Mobile Comments at 5-6. T-Mobile states that it plans to deploy UMTS (WCDMA) mobile devices in its AWS-1 spectrum. See *id.* at 5.

⁶⁹ T-Mobile uses 3GPP standards for in-band interference level (-56 dBm) and minimum adjacent channel selectivity (33 dB). See 3GPP TS 25.101 §7.5.1 and §7.6.1.

⁷⁰ For example, using T-Mobile's methodology and the 3GPP standards, the maximum permissible AWS-3 mobile power would be 23 dBm (200 mW) at a two-meter separation, and 31 dBm (1.25 W) at a five-meter separation.

B. The Commission Should Insist on the Use of Appropriate RF Filters

Adjacent channel interference can be mitigated by using AWS-1 (and AWS-2) receivers with appropriate adjacent channel selectivity (“ACS”) and state-of-the-art RF filters designed to pass *only* the 2110-2155 MHz band (or the 2175-2180 MHz band for receivers in AWS-2 band). Such filters are not readily available today because manufacturers have willingly chosen to design filters with a wider passband for a global market.⁷¹ Furthermore, certain manufacturers and service providers have chosen to use such technology in order to suit their own “practical and economic” needs,⁷² but their short-sighted choices in this regard should not control the Commission’s decisions in this proceeding. AWS-1 licensees have been on notice for years that services, including TDD services, could enter the 2155-2175 MHz band,⁷³ and current AWS filter designs could be modified easily to pass only the narrower AWS-1 band (45 MHz instead of 65 MHz). With current filter designs, a 30% narrower passband could result in a sharper cutoff and thus provide greater attenuation. Further, RF filter designs with less temperature sensitivity are available and could be used to the extent that temperature variations pose a problem in filter performance. It should be possible to incorporate redesigned filters in all future AWS-1 mobile devices with essentially no increase in recurring costs.⁷⁴

For filtering to be effective, there must be adequate frequency spacing to allow a filter to achieve the desired amount of rejection. An *internal* guard band or transition band between the AWS-3 mobile transmitter frequency and the AWS-1 mobile receiver frequency could be used to provide adequate filter slope to attenuate the interfering signal. This could be provided by

⁷¹ See 3GPP TS 25.101 §7.5.1 and §7.6.1.

⁷² See Verizon Wireless Comments at 9; see also Motorola Comments, App., at A-3 (asserting that “current AWS-1 duplexers do not provide much attenuation from operations in 2155-2175 MHz”).

⁷³ See *AWS Third Report and Order* ¶ 69.

⁷⁴ Current thin film bulk acoustic resonator (“FBAR”) technology filters for the 2.1 GHz band are priced under \$1.00 for bulk quantities and are used in WCDMA FDD systems.

implementing transition zones in the AWS-3 band and in the adjoining AWS-1 (and AWS-2) bands, and could provide operators with flexibility to determine the appropriate mechanism (transition zone, filter technology, transmit power, etc.) to satisfy the neutral technical rules that the Commission should adopt in this proceeding.⁷⁵

A transition zone could be used in the AWS-3 band because operational TDD channels could not be placed at the edge of the 2155-2175 MHz band without causing such TDD channels' own base station receivers to experience harmful interference from base station transmitters in the adjacent AWS-1 and AWS-2 bands. TDD operators in the AWS-3 band therefore would need to incorporate an internal transition zone to offset TDD channels from the edges of the AWS-3 band.⁷⁶ This transition zone would allow TDD base station receivers to filter out transmissions from adjacent channel base station transmitters in order to prevent harmful interference.⁷⁷

Using these mechanisms in combination will greatly reduce the possibility of harmful interference. For example, the AWS-3 transition zone also would provide additional frequency separation between TDD operations and adjacent channel operations, thus enabling appropriate AWS-1 mobile receive filters to attenuate transmissions from AWS-3 mobile devices even more effectively. Therefore, the fact that an eventual AWS-3 licensee using TDD technology would need to protect its own base stations against harmful interference would provide an additional safeguard to adjacent channel licensees against the possibility of receiver-overload interference.

⁷⁵ The transition zone in the adjacent band results from the fact that the Commission typically has allocated spectrum in block sizes in excess of the required channel spacing. Thus, when a carrier is centered, there is unused spectrum on either side. For example, a UMTS WCDMA carrier has a width of 3.84 MHz and a channel spacing of 5.0 MHz. This provides a transition zone of 580 kHz on either side.

⁷⁶ In the 2.5 GHz band, BRS-EBS operators that use TDD technologies, such as WiMAX, design their systems to operate with at least three megahertz of separation from other non-synchronized TDD operations or FDD systems. *See* Sprint Nextel Comments at 10-11).

⁷⁷ In the AWS-3 band at 2.1 GHz, TDD operators likely would need smaller "transition zones" than in the BRS-EBS band at 2.5 GHz, because the AWS-3 band is lower in frequency.

III. THE COMMISSION SHOULD INCORPORATE M2Z’S PROPOSED SERVICE RULES

A. The 2155-2175 MHz Band Should Be Licensed

The overwhelming majority of parties that submitted comments in this proceeding implicitly supported licensing the AWS-3 band, whether pursuant to auction or otherwise, and acknowledged the wisdom of auctioning rights to use the spectrum as opposed to specifying the band for unlicensed operations.⁷⁸ For example, although Free Press, Media Access Project, New America Foundation, and Public Knowledge state each entity’s typical preference is unlicensed use of spectrum, their comments acknowledge that “based on the technical attributes of this band, unlicensed uses may not be the most effective use.”⁷⁹ These commenters cite technical assessments suggesting “that unlicensed uses likely will not support WiFi-like or other broadband-like technologies,” meaning that unlicensed use of the 2155-2175 MHz band “seem[s] unlikely to inject considerable competition in network provision.”⁸⁰ Free Press, MAP, New America Foundation, and Public Knowledge thus conclude that they “would favor a licensed approach subject to openness mandates” for the AWS-3 band.⁸¹ M2Z agrees with these commenters’ conclusion that licensed use, along with the adoption of other specific service rules and public interest requirements discussed below and set forth in greater detail in M2Z’s initial comments in this proceeding, would hasten broadband deployment and promote new entry and increased competition.⁸²

⁷⁸ *But see, e.g.*, Comments of Comsearch, WT Docket No. 07-195, at 4 (filed Dec. 14, 2007); Comments of Tropos Networks, WT Docket No. 07-195, at 1-5 (filed Dec. 14, 2007). M2Z is aware of no other comments, among the dozens filed in the initial comment round, that supported unlicensed use of the AWS-3 band.

⁷⁹ Free Press *et al.* Comments at 9.

⁸⁰ *Id.* at 9-10.

⁸¹ *Id.* at 10.

⁸² *See* M2Z Initial Comments at 9.

B. The Commission Should License the 2155-2175 MHz Band as a Single Nationwide 20 MHz Block

1. A 20 MHz License Block Would Promote the Efficient and Intensive Use of the Band

M2Z agrees with Sprint Nextel and WCA that a single 20 MHz block is best-suited for the AWS-3 band. A 20 MHz block would “encourage the development of highly competitive broadband systems,”⁸³ and enable “a substantial opportunity to deploy robust TDD systems using technologies compliant with the IEEE 802.16e-2005 standard.”⁸⁴ Larger spectrum blocks provide a licensee with more useable spectrum and, as the Commission has explained previously, 20 MHz or larger spectrum blocks “enable a broader range of broadband services (including Internet access at faster speeds), accommodate future higher data rates, and provide operators with additional capacity and, importantly, flexibility.”⁸⁵

A single 20 MHz block in AWS-3 would also promote spectral efficiency. For wireless networks, spectral efficiency depends upon the quantity of users or services that can be simultaneously supported by a limited radio frequency bandwidth within a defined geographic area. By avoiding rules that would unnecessarily split up the available spectrum in the 2155-2175 MHz band, the Commission would maximize the amount of the band that actually is used for data transmissions.⁸⁶ As Table 1 demonstrates by averaging measurements for WiMAX,

⁸³ Sprint Nextel Comments at 14.

⁸⁴ WCA Comments at 5.

⁸⁵ *700 MHz August 2007 Second Report and Order* ¶ 69 (citing *Service Rules for Advanced Wireless Services in the 1.7 and 2.1 GHz Bands*, Order on Reconsideration, 20 FCC Rcd 14058, ¶ 15 (2005)); see also *Service Rules for Advanced Wireless Services in the 1.7 and 2.1 GHz Bands*, Report and Order, 18 FCC Rcd 25162, ¶ 44 (2003).

⁸⁶ Although an argument can be made that the amount of data transmitted is a better measure of spectral efficiency, that metric depends upon the technology, network architecture, and deployment strategy of the licensee (all of which are technology-specific parameters) and likely can be incorporated into any band plan.

UMTS, and WCDMA,⁸⁷ a single 20 MHz block in the 2155-2175 MHz band would be more spectrally efficient than two 10 MHz blocks or four 5 MHz blocks.⁸⁸ A single 20 MHz block also provides significant efficiency advantages for each of the technologies presented.⁸⁹

TABLE 1

Blocks	Block Size	WiMAX	UMTS	WCDMA	Efficiency
1	20 MHz	<i>19.5 MHz</i>	<i>19.2 MHz</i>	<i>18.7 MHz</i>	<i>0.957</i>
2	10 MHz	<i>19.0 MHz</i>	<i>15.4 MHz</i>	<i>17.5 MHz</i>	<i>0.865</i>
4	5 MHz	<i>18.0 MHz</i>	<i>15.4 MHz</i>	<i>15.0 MHz</i>	<i>0.807</i>

For all the reasons outlined above, a single 20 MHz band would be consistent with the Congressional mandate ordering the Commission to “include safeguards to protect the public interest in the use of the spectrum”⁹⁰ and promote the “efficient and intensive use of the electromagnetic spectrum.”⁹¹

⁸⁷ WiMAX currently is the technology choice of providers such as Clearwire and Sprint, UMTS currently is the technology choice of 3GPP, and WCDMA currently is the technology choice of 3GPP2. Because LTE is a multicarrier technology similar to WiMAX, M2Z assumes that the WiMAX data in Table 1 will suffice for comparison purposes.

⁸⁸ The calculations here also assume that a 250 kHz internal guard region is necessary between each licensee and that WiMAX can be deployed in 4.5, 9.5, and 19.5 MHz blocks (*see* IEEE 802.16 standard); UMTS is deployed in 3.84 MHz blocks; and WCDMA is deployed in 1.25 MHz blocks.

⁸⁹ A 20 MHz block size requires an average of 860 kHz across three of the dominant technologies for internal guard bands at the outer edges of the block. However, a configuration with four 5-MHz blocks would require an average of 3.8 MHz, since the internal guard bands would be at the edges of each of the four sub-blocks. Additional inefficiencies are manifested in how much of the sub-block is used for transmitting data.

⁹⁰ 47 U.S.C. § 309(j)(3).

⁹¹ *Id.* § 309(j)(3)(D).

2. A Single Nationwide License Would Simplify Deployment and Interference Mitigation

Assigning the AWS-3 band as a single nationwide license would greatly ease deployment and implementation issues and simplify the harmful interference mitigation techniques used to minimize adjacent channel interference.

Use of AWS-3 spectrum will require the development and implementation of interference mitigation strategies that cover the adjacent AWS-1 and AWS-2 bands. An important component of this strategy will, of necessity, involve inter-operator cooperation and coordination. This cooperation and coordination between operators would be simplified greatly if there were a single AWS-3 band licensee. By contrast, assigning the AWS-3 spectrum to multiple licensees would create a number of geographic service boundaries requiring coordination. As Sprint Nextel explained in its comments, “establishing larger geographic service area boundaries . . . will allow for cost-effective deployment of regional or national wireless broadband systems regardless of whether those systems use TDD or downlink-only configurations.”⁹² Sprint Nextel noted that “[r]elying on larger geographic service areas also limits the number of geographic service boundaries where signal strength and height benchmarking limitations would need to be considered by unsynchronized TDD and downlink-only AWS-3 licensees.”⁹³ Establishing a nationwide license area would allow for the most cost-effective deployment and operation.⁹⁴ Indeed, the same analysis used by the Commission in the 1670-1675 MHz proceeding applies here:

⁹² Sprint Nextel Comments at 15.

⁹³ *Id.*

⁹⁴ See Letter from Donald C. Brittingham, Director of Wireless Matters, Bell Atlantic, to Ms. Magalie Roman Salas, Secretary, Federal Communications Commission, WT Docket No. 99-168, at 2 (filed Nov. 16, 1999) (“Nationwide licensing will promote increased operating efficiencies and lower priced services without the expense and delay of aggregating smaller geographic areas through the secondary market.”).

[W]e believe that nationwide licensing in the 1670-1675 MHz band serves the public interest by promoting flexibility and efficient spectrum markets and facilitates the deployment of ubiquitous, innovative communications services to the public. We also believe nationwide licensing in this band will provide economies of scale for those seeking to offer new technology. In this connection, we have on more than one occasion noted that nationwide assignments are more likely to stimulate investment in new technologies and can provide a critical means of achieving greater spectrum efficiency and promoting research and development.⁹⁵

Moreover, the presence of a single nationwide licensee for the AWS-3 band would also eliminate the potential for co-channel interference and obviously would simplify and shorten the network deployment process.

C. The Commission Should Establish Public Interest Obligations for the 2155-2175 MHz Licensee

For many wireless carriers, a discussion concerning what constitutes the “public interest” is an exercise they would rather avoid. Instead of engaging in the discussion on the merits, they claim that the Commission need not provide regulatory guidance because they have every incentive to do what is in the public interest.⁹⁶ Such sweeping and self-serving assertions, however, would call into question *every* regulation – including those designed for the safety of consumers. Suggestions that the interests of consumers are perfectly aligned with the interests of their service providers in every instance ignore the realities of highly concentrated wireless and wireline broadband markets. While consumers enjoy using many of the telecommunications and information services that they currently receive, the reality is that many are also dissatisfied with their current service providers.⁹⁷ The question is – who should bridge the gap? Most wireless

⁹⁵ See *Amendments to Parts 1, 2, 27 and 90 of the Commission's Rules to License Services in the 216-220 MHz, 1390-1395 MHz, 1427-1429 MHz, 1429-1432 MHz, 1432-1435 MHz, 1670-1675 MHz, and 2385-2390 MHz Government Transfer Bands*, Report and Order, 17 FCC Rcd 9980, ¶ 21 (2002).

⁹⁶ See, e.g., CTIA Comments at 11.

⁹⁷ A recent JD Power and Associates survey of 16,000 residential Internet service customers found that respondents with dial-up connections reported higher customer satisfaction and greater loyalty to their provider than respondents with broadband. See “High-Speed Internet Subscribers are Less Loyal to Their Providers Than are Dial-Up Subscribers, Despite Steady Growth in High-Speed Internet Market Share” (Sept. 19, 2007), *available*

carriers and other service providers argue that “competition” should close the gap and point to the mobile voice marketplace as evidence. The mobile voice market, however, is distinct from the broadband market.

Perhaps the greatest impediment today to realization of the promise of the digital revolution is the fact that the broadband market is a duopoly, limiting consumer choice and enervating competitive pressures that might otherwise drive prices down. Indeed, the Government Accountability Office (“GAO”)⁹⁸, the Congressional Budget Office (“CBO”)⁹⁹ and the Congressional Research Service (“CRS”)¹⁰⁰ have reached the same conclusion.¹⁰¹ Clearly, more broadband competition would dramatically improve consumer choice and benefits, and in light of current market conditions, the Commission should actively seek to promote the public interest and facilitate the creation of these consumer benefits. Indeed, just a few months ago the Commission recognized the need for regulatory guidance in this area, as it adopted open platform requirements in the 700 MHz proceeding for a 22 MHz spectrum block in order to

at <http://www.jdpower.com/press-releases/pressrelease.aspx?id=2007210>. Given the glacial speed of a dial-up connection and the plethora of services and applications that are patently impossible to use at dial-up speeds, the survey results clearly indicate that broadband providers are failing to provide consumers with the level of services that consumers expect at prices they can afford.

⁹⁸ United States Government Accountability Office, “Broadband Deployment is Extensive throughout the United States, but It Is Difficult to Assess the Extent of Deployment Gaps in Rural Areas,” GAO-06-426 (May 2006), available at <http://www.gao.gov/new.items/d06426.pdf>.

⁹⁹ Congressional Budget Office, “Does the Residential Broadband Market Need Fixing?” (Dec. 2003), available at <http://www.cbo.gov/ftpdoc.cfm?index=4868&type=0>.

¹⁰⁰ Charles B. Goldfarb, Congressional Research Service, “Access to Broadband Networks,” (June 29, 2006), available at http://www.ipmall.info/hosted_resources/crs/RL33496_060629.pdf.

¹⁰¹ Similarly, Commission reports on the status of broadband Internet access show that incumbent local exchange carriers (“LECs”) and cable operators dominate the residential broadband market, with LECs serving 41.3% of the market, and cable operators serving 57.5% of residential broadband subscribers. See Federal Communications Commission, *High-Speed Services for Internet Access: Status as of December 31, 2005*, at 3 (rel. July 2006), available at http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-266596A1.pdf. There are 42.9 million residential broadband lines in the U.S., and only 1.2% of all residential broadband subscribers use other technologies. See *id.* According to the Census Bureau, there were 113 million households in the United States in 2005. See U.S. Census Bureau, “Households by Type, 1940 to the Present,” May 25, 2006 (available at <http://www.census.gov/population/socdemo/hh-fam/hh1.pdf>). The percentage of households with broadband access is therefore approximately 38%.

enhance device and application choices and facilitate competition in the nascent wireless broadband market.¹⁰² In addition, the Commission adopted geographic-based buildout requirements for CMA and EA licenses. In stark contrast to the “leave it to the market” philosophy that some parties have advocated in response to the NPRM in this docket, Chairman Martin explained in the 700 MHz proceeding that the Commission is now inclined to protect the public interest through “[s]tringent build-out requirements – the toughest ever imposed by the Commission – [that] will ensure that this spectrum is put to use quickly in both urban and rural areas. Those who fail to follow through will face tough penalties including the loss of spectrum.”¹⁰³

Multiple commenters in this proceeding support the use of licensee obligations to ensure that the AWS-3 band licensee’s use of the spectrum is in the public interest. For example, Free Press, Media Access Project, New America Foundation, and Public Knowledge encourage the Commission to adopt openness rules to promote broadband competition, including competition for handsets and applications.¹⁰⁴ They also support the use of “strict threshold qualifications and regulations” to further the public interest.¹⁰⁵

Other commenters also support the use of public interest obligations specifically to facilitate broadband deployment. The Minority Media and Telecommunications Council and the Rainbow/PUSH Coalition assert that the Commission should require the AWS-3 band licensee to provide a free, nationwide broadband service.¹⁰⁶ They indicate that a free broadband service

¹⁰² 700 MHz August 2007 Second Report and Order ¶¶ 195-206.

¹⁰³ *Id.* (Statement of Chairman Kevin J. Martin).

¹⁰⁴ *See* Free Press *et al.* Comments at 8.

¹⁰⁵ *Id.* at 7.

¹⁰⁶ *See* MMTTC and Rainbow/PUSH Comments at 1-2; *see also* Coalition for Free Broadband Now Comments, WT Docket No. 07-195 (filed Dec. 14, 2007) (collecting comments of individuals supporting Commission action to facilitate a free, wireless broadband offering in the 2155-2175 MHz band).

would help minority entrepreneurs by increasing broadband access and bringing the cost of online advertising within reach.¹⁰⁷ They also state that a licensee obligation to provide a free broadband service can help resolve current racial disparities in broadband adoption.¹⁰⁸ The Electronic Retailing Association also favors a free service requirement:

[b]y promulgating rules for this band that require the eventual licensee to provision a free broadband services on a nationwide basis, the FCC will resolve a pressing market failure, bridge the digital divide, bolster our nation's ability to compete globally, and aid business, municipalities, and average Americans enjoy broadband for affordably and reliably.¹⁰⁹

These commenters are hardly alone. They are joined by hundreds of others who, during the course of the Commission's M2Z license application proceeding, called on the Commission to ensure affordable access to broadband Internet services.¹¹⁰

The Higher Education Wireless Access Consortium ("HEWAC") and College Parents of America ("CPA"), two national education advocacy organizations, also have requested that the Commission ensure that the AWS-3 band is used for the deployment of an affordable broadband Internet service. These parties support a free service in order to bridge the digital divide, build a more skilled workforce, and ensure that America remains an innovation leader in the world.¹¹¹ HEWAC and CPA also advocated for the inclusion of a mandate to filter the AWS-3 broadband service for indecent and pornographic material in order to spur the development of child protective technologies by generating greater competition for this differentiating service component.¹¹²

¹⁰⁷ MMTC and Rainbow/PUSH Comments at 11-12.

¹⁰⁸ *Id.* at 9-11.

¹⁰⁹ Comments of the Electronic Retailing Association, WT Docket No. 07-195, at 10 (filed Dec. 14, 2007).

¹¹⁰ *See, e.g.*, M2Z Initial Comments at 15-17 (discussing comments submitted in WT Docket Nos. 07-16 and 07-30).

¹¹¹ Comments of the Higher Education Wireless Access Consortium and College Parents of America, WT Docket No. 07-195, at 7 (filed Dec. 14, 2007).

¹¹² *Id.*

In its comments, the Family Research Council (“FRC”) also supported licensee obligations requiring a free broadband service, and argued that the licensee additionally should be required to offer “family-friendly” Internet service.¹¹³ FRC explained that Section 230 of the Communications Act provides the Commission with adequate authority to protect children through the adoption of such rules.¹¹⁴ FRC believes that: “[w]ith access to a free *and* family-friendly nationwide broadband service, acting as a *safe haven*, every family in America will be able to benefit from broadband technologies.”¹¹⁵

The Vermont Telecommunications Authority encouraged the Commission to require the AWS-3 band licensee to provide universal broadband service, noting that a digital divide remains in rural and underserved areas.¹¹⁶ Moreover, Dr. Simon Wilkie encouraged the Commission to adopt open device and application requirements, a five-year spectrum holding requirement, and enforceable buildout requirements to avoid spectrum speculation and warehousing.¹¹⁷ Such obligations would build on the precedent established in the 700 MHz proceeding in which the Commission seeks greater assurances from licensees that spectrum will be quickly put to use.

The National Association of Telecommunications Officers and Advisors (“NATOA”) echoed the comments of many of these parties in calling for the provision using the AWS-3 band of a free service with clear and enforceable buildout requirements. NATOA added that the eventual licensee of the AWS-3 band should be required to build a network that is interoperable

¹¹³ Comments of the Family Research Council, WT Docket No. 07-195 (filed Dec. 14, 2007) (“FRC Comments”); *see also* Comments of Senator-Elect Lee Yancey, WT Docket No. 07-195 (filed Dec. 14, 2007) (supporting a free, family-friendly Internet service in the AWS-3 band).

¹¹⁴ *See* FRC Comments at 3, 14.

¹¹⁵ *Id.* at v (emphases in original).

¹¹⁶ Comments of the Vermont Telecommunications Authority, WT Docket No. 07-195, at 2-4 (filed Dec. 14, 2007).

¹¹⁷ *See* Letter from Dr. Simon Wilkie, Ph. D., to Chairman Kevin Martin, Federal Communications Commission, WT Docket No. 07-195 (Dec. 14, 2007).

with planned and existing IP-based public safety networks.¹¹⁸ This requirement would allow an additional layer of redundancy for the national public safety communications network, thereby increasing the likelihood of sustained communications operability when disasters or public safety emergencies occur.

Each of the public interest requirements sought by M2Z and numerous other commenters in this proceeding will either benefit consumers, discipline the 2155-2175 MHz licensee, or both. Therefore, M2Z recommends they all be reflected in the service rules adopted by the Commission for the 2155-2175 MHz band.

¹¹⁸ Comments of the National Association of Telecommunications Officers and Advisors, WT Docket No. 07-195, at 2-3 (filed Dec. 14, 2007).

IV. CONCLUSION

M2Z has long believed that the 2155-2175 MHz band should be utilized to dramatically and positively impact broadband availability, accessibility, and affordability. We believe that the Commission can easily achieve this goal by (i) establishing technologically neutral and flexible technical rules and (ii) imposing meaningful licensee public interest obligations. M2Z urges the Commission to reject the calls for Commission-dictated technology choices, at one extreme, as well as calls for service rules that would fail to provide any regulatory guidance or impose any public interest requirements at the other. M2Z suggests, instead, a balance between allowing the AWS-3 licensee its choice of technology and operations pursuant to flexible technical rules and ensuring that the licensee fulfills concrete and definite public interest obligations. M2Z thus requests that the Commission adopt the service rules that M2Z proposed in its initial comments in this proceeding, and urges the Commission to license the AWS-3 band immediately.

Respectfully submitted,



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APPENDIX A

Mitigation of Interference between Time-Division Duplex and Frequency-Division Duplex Technologies

Mitigation of Interference between Time-Division Duplex and Frequency-Division Duplex Technologies

Introduction

The presence of base and mobile transmissions in the same band, such as from a time-division duplex (“TDD”)¹ system, adjacent to a frequency division duplex (“FDD”)² band designated for base transmissions, creates the possibility for certain types of adjacent channel interference scenarios. The possibility of interference between TDD and FDD systems operating on adjacent frequencies within the 2500-2690 MHz band has been examined by the International Telecommunication Union.³ U.K. regulator Ofcom⁴ and the WiMAX Forum also have considered TDD and FDD coexistence.⁵ Taken as a whole, these studies demonstrate that harmful interference between TDD and FDD systems can be effectively mitigated.

AWS-3 Interference Scenarios

The AWS-3 band at 2155-2175 MHz, as shown below, is a 20 MHz block of unpaired spectrum that adjoins bands allocated for downlink FDD operations. Immediately below 2155 MHz, the spectrum is assigned to AWS-1 licensees for terrestrial base station downlinks. Under rules adopted by the Commission, the AWS-1 band could be used for either fixed or mobile use.⁶

¹ Time division duplex (TDD) is a technique for using the same frequency both for communications from base stations to subscribers as well as in the opposite direction, from subscribers to base stations. In TDD systems, the same frequency is used for communications in both directions. Thus, TDD technology can be implemented using a single block of spectrum.

² Frequency division duplex (FDD) uses two distinct and separate frequencies for the communications “downlink” (from base stations to users) and communications “uplink” (from users to base stations). As a result, FDD requires paired spectrum blocks.

³ See Report ITU-R M.2030 “Coexistence between IMT-2000 time division duplex and frequency division duplex terrestrial radio interface technologies around 2600 MHz” (2003) (“ITU 2003 Report”). This report stated that it was “based on deterministic calculations for BS-BS scenarios leading to required separation distance and/or isolation requirements or supported cell range. The interference from MSs into MSs and BSs is analysed both with deterministic and statistical calculations leading to capacity loss and/or probability of interference.” *Id.* The ITU investigated the interference problems between WCDMA FDD and CDMA TDD systems, when operated in adjacent frequencies within the 2500-2690 MHz band and in the same geographical area. *See id.*

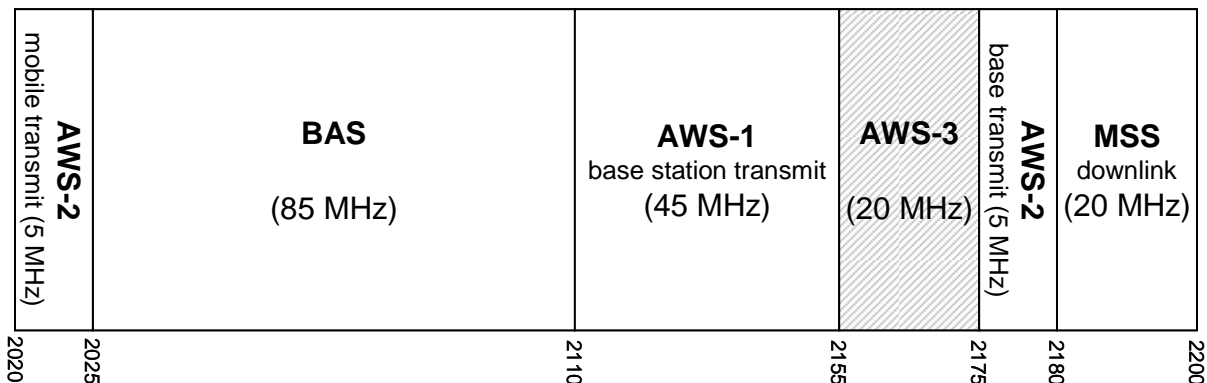
⁴ Mason Communications, Ltd., “2500-2690MHz, 2010-2025MHz and 2290-2302MHz Spectrum Awards – Engineering Study (Phase 2),” App. A, at 9-13 (Nov. 2006), available at <http://www.ofcom.org.uk/consult/condocs/2ghzawards/masonresearch.pdf> (“Ofcom Report”).

⁵ WiMAX Forum, “Service Recommendations to Support Technology Neutral Allocations, FDD/TDD Coexistence,” (Apr. 10, 2007).

⁶ See *Amendment of Part 2 of the Commission’s Rules to Allocate Spectrum Below 3 GHz for Mobile and Fixed Services to Support the Introduction of New Advanced Wireless Services, including Third Generation Wireless Systems*, Eighth Report and Order, Fifth Notice of Proposed Rulemaking and Order, 20 FCC Rcd 15866 (2005).

Immediately above the 2155-2175 MHz band, the spectrum is allocated for AWS-2 (pending a rulemaking to establish technical rules).⁷ In the 2180-2200 MHz band, the spectrum is licensed to mobile-satellite service (“MSS”) downlinks (space-to-earth) and can be used, eventually, for MSS ancillary terrestrial component (“ATC”) base stations.⁸

Bands Neighboring AWS-3



Thus, an AWS-3 band licensee using TDD technology would have to deal mainly with issues concerning its lower and upper spectral neighbors, which are both downlink/base station transmit frequencies. (The downlink base transmit frequency is also the mobile receive frequency). The most critical interference scenarios presented by such an arrangement are “mobile-to-mobile” interference from a handset transmitting in the AWS-3 band near a mobile device receiving in an adjacent band and “base-to-base” interference from a base station transmitting in the AWS-3 band near a base station receiving in an adjacent block in the AWS-3 band – since, in a mobile environment, base stations and mobiles can often be found situated very close together.⁹

Interference Mitigation Techniques

The traditional approach to addressing potential interference concerns would be to prescribe limits on transmitter powers, emissions and signal strength and to specify guard frequency bands to provide isolation between adjacent systems. Guard bands, however, are generally a wasteful solution that can limit flexibility and prohibit solutions that might make use of otherwise unusable spectrum.

⁷ See *Service Rules for Advanced Wireless Services in the 1915-1920 MHz, 1995-2000 MHz, 2020-2025 MHz and 2175-2180 MHz Bands*, Notice of Proposed Rulemaking, 19 FCC Rcd 19263 (2004).

⁸ ATC authority allows MSS operators to also use their satellite radio frequencies for a complementary terrestrial wireless service, using the allocated and assigned MSS downlink (space-to-earth) and uplink (earth-to-space) frequencies.

⁹ See *Service Rules for Advanced Wireless Services in the 2155-2175 MHz Band*, Notice of Proposed Rulemaking, 22 FCC Rcd 17035, ¶ 51 (2007).

In addition to the interference abatement measures mentioned above, there are a variety of available techniques that can be used to prevent harmful interference between TDD and FDD systems operating in adjacent frequency bands and in the same geographic area. The ITU identified in a subsequent report a number of techniques to improve compatibility between TDD and FDD in the 2500-2690 MHz band.¹⁰ Ofcom also has examined interference mitigation techniques that could enable the co-existence of FDD and TDD technologies.¹¹ Ofcom concluded that operations of TDD and FDD systems in adjacent frequency blocks in the same band could be possible with consideration of suitable interference mitigation techniques.¹² As stated in the later ITU report, although a *single technique may not provide full mitigation in all scenarios*, a combination of techniques can be used to mitigate TDD-FDD interference in many situations.

The interference mitigation techniques described by the above-referenced reports are also applicable to other frequency bands – i.e. the AWS bands and to other TDD and FDD radio interfaces. Thus, based on this work, there is clear evidence that TDD systems deployed in the 2155-2175 MHz band can co-exist with FDD systems deployed in the adjacent AWS-1 and AWS-2 bands.

The following is a short description of the mitigation techniques appropriate to TDD systems deployed in the AWS-3 band.

A. Base Station Siting¹³

There is a risk of base-to-base interference when a TDD base station is situated near an FDD base station. Similarly, there will be a risk of interference when two TDD base stations in the AWS-3 band are situated near each other. Coordinating the location of base stations to avoid close spacing could help minimize any adverse interaction. Base station isolation can also be increased by taking advantage of terrain and building obstructions.

B. Antenna Polarization¹⁴

Base station radio systems can get additional isolation by using antennas with different polarizations.¹⁵ For example, the use of vertical polarization on one antenna and horizontal polarization on the other can increase isolation by several dB. Antenna polarization could

¹⁰ See Report ITU-R M.2045, “Mitigating techniques to address coexistence between IMT-2000 time division duplex and frequency division duplex radio interface technologies within the frequency range 2500-2690 MHz operating in adjacent bands and in the same geographical area” (2004) (“ITU 2004 Report”).

¹¹ Ofcom Report, App. A, at 9-13.

¹² See *id.* at 7.

¹³ See ITU 2004 Report § 5.1; see also Ofcom Report, App. A, at 10.

¹⁴ See ITU 2004 Report § 5.3; see also Ofcom Report, App. A, at 10.

¹⁵ Polarization characterizes electromagnetic waves, such as light and radio waves, by specifying the direction of the wave’s electric field. All radio transmitting and receiving antennas are intrinsically polarized. In addition to vertical and horizontal polarizations, more complex circular polarizations are possible with a penalty in antenna size.

provide additional needed isolation in cases where the path loss between two base stations is insufficient.

C. Adaptive Antennas¹⁶

An adaptive antenna (or smart antenna) is an antenna that is able to change (adapt) its antenna pattern dynamically to adjust to noise, interference and multipath. By changing the antenna pattern, adaptive antennas can enhance received signals and can be used to form beams (i.e. beamforming) for transmission. Thus, adaptive antennas can be designed to focus the radiated power in limited, specific regions of a cell, while reducing the power transmitted in other directions.¹⁷ A benefit of adaptive antennas is that the radiated RF energy is more uniform over the service area – avoiding the hot spots of more conventional antennas.

D. Base Station Transmitter/Receiver Improvements¹⁸

Filtering of amplifiers can be used to reduce the unwanted out-of-band emissions (OOBE) from a base station. OOBE can also be controlled by improving transmitter linearity (to prevent the generation of OOBE). Improving amplifier linearity with better components and better design limits OOBE, as does shaping the signal *before* the amplifier.

Similarly, filtering at the base station receiver can reduce interference. Improved receiver technology is becoming more available in terms of increased rejection of signals in the adjacent band and in handling near/far problems.¹⁹ With the overall interference reduced, base stations could operate closer to each other, use greater transmitter power or both while maintaining a desired interference level.

E. Power Control²⁰

Automatic transmitter power control (“ATPC”) is used on the downlink of TDD systems to increase system capacity and is an integral part of the TDD standard. By tight application of ATPC, a TDD system can limit the amount of radio power in the adjacent bands to the minimum possible given the OOBE limits.

¹⁶ See ITU 2004 Report § 5.4; *see also* Ofcom Report, App. A, at 10.

¹⁷ In the case of TDD, because transmissions to and from the base station are on the same frequency, the return path from the base station to the user is virtually identical to the path from the user to the base station, the focusing is more precise, and the performance is improved. In contrast, FDD systems are limited in their ability to utilize AAS technology in both the downlink and uplink directions since these systems lack channel reciprocity. In FDD, the two paths are on separate frequencies and therefore are somewhat different. As a result, FDD systems will typically implement advanced antenna technology only at the base station in the transmit direction. This difference reduces the effectiveness of beamforming.

¹⁸ See ITU 2004 Report § 5.5; *see also* Ofcom Report, App. A, at 10.

¹⁹ Radio receivers are susceptible to “near/far” problems – that is, they have a limited capability of receiving and detecting a weaker signal in the presence of a stronger signals.

²⁰ See ITU 2004 Report § 5.6; *see also* Ofcom Report, App. A, at 11.

In addition to increasing system capacity, power control can also provide added immunity to downlink interference, as the base station can adapt the power it transmits to a TDD mobile, to counter the interference on an adjacent frequency.

F. Mobile Handover²¹

Handover is incorporated into cellular type mobile systems to facilitate mobility. While not designed to mitigate interference, handover can provide a work around to interference.²² By handing off the mobile station, a change is introduced (different RF channel, time slot, frequency band, etc.), and in that process the system has the ability to choose a better channel.

Thus, interference can be avoided, in some cases, by the operators of the FDD and TDD systems making extra inter-site handoffs when possible. In particular, such handoffs can help to avoid TDD base station to FDD mobile interference, if real time information is shared between the FDD and TDD operators.

G. Inter-System Frequency Coordination

If the FDD system adjacent to the TDD system is implemented using a technology with a frequency reuse factor greater than one, then it may be possible to minimize mutual interference by coordinating frequency use with the operator of the adjacent systems. In this case, an individual base station would not use the entire system block but rather a fraction of it, with some of these fractional blocks adjacent to the AWS-3 band. If as part of mutual negotiations to address mutual interference concerns, the two neighboring licensees could negotiate on which frequency block of the lower band is used for a particular base station site, some interference potential could be eliminated.

H. Cognitive Radio Technology for Interference Control²³

Generally, cognitive radio technology is viewed as a way of finding spectrum for use on an interference free basis. However, cognitive radio technology can be used to reduce interference to other users by selecting the transmission parameters, such as frequency, power, and antenna pattern of each transmission to minimize interference to adjacent band users.

²¹ See ITU 2004 Report § 5.7; *see also* Ofcom Report, App. A, at 11.

²² Handover is used often by cellular radiotelephone systems to gain extra capacity by offloading users from cells that have traffic surges into adjacent cells that have overlapping coverage. This is referred to as making “extra inter-site handoffs.”

²³ *See Facilitating Opportunities for Flexible, Efficient, and Reliable Spectrum Use Employing Cognitive Radio Technologies*, Report and Order, 20 FCC Rcd 5486, ¶ 22 (2005). For other discussions on the use of cognitive radio technology to reduce interference, see Bruce Fette, “Cognitive Radio Technology,” at 60-61 (2006).